IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:	Confirmation No.: 3817
Nicholas L. Abbott, *et al.*	Examiner: Lundgren, Jeffrey S.
Application No.: 10/044,899	Technology Center/Art Unit: 1639
Filed: 01-09-2002	DECLARATION OF NICHOLAS L. ABBOTT, UNDER 37 C.F.R. § 1.132
For: Optical Amplification of Molecular Interactions Using Liquid Crystals	
Customer No.: 43850	

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Nicholas L. Abbott, state and declare that:

1. I am an inventor of the instant application.

2. I am also an inventor of U.S. Patent Application Serial No. 10/934,023 (the '023 application) and submitted a Declaration in support of the claims of that application dated June 11, 2008.

3. The Examiner states on page 4 of the Office Action that my Declaration submitted in support of the '023 application indicates that the liquid crystal biosensors of the instant application are dependent on the use of an anisotropic gold substrate surface and organic self-assembled monoloayers. I stated that the nature of the gold films plays the central role in the orientations assumed by the liquid crystal in U.S. Patent No. 6,284,197 (the '197 patent), a parent of the instant application, and that the orientations assumed by the liquid crystal are inconsistent with those that would be observed if the corrugation of the surface depicted in Figure 1B of the instant application were responsible for the ordering of the liquid crystal. This statement highlighted the distinction between the mechanism for liquid crystal orientation by

anisotropic gold surfaces as opposed to surfaces which contain nanoscale topography of the type claimed in the '023 application. These statements were in reference to Figure 1B, which does depict an anisotropic gold surface. I did not state that the sensors of the instant application were limited to the use of anisotropic gold surfaces. I note this is also consistent with the later response dated July 15, 2009, made in the '023 application, which further addressed the topography distinction. Those responses indicated that the Examiner had misconstrued my statements and that anisotropic gold surfaces were not excluded from the claims of the '023 application.

4. The instant application describes a variety of substrates and surface treatments that can be used to make biosensors that use liquid crystal orientation as a reporting mechanism. The application describes that the substrate surfaces are treated in order to provide a surface that can anchor mesogens. These surfaces are utilized in the biosensors. Below, I provide specific examples of the substrates and surface treatments and provide specific references to where the description occurs in the application.

5. The application describes a variety of substrates. The substrates include inorganic crystals and glasses (¶148), inorganic oxides (¶150), metals such as gold, silver, platinum, palladium, nickel and copper that are deposited by multiple methods (¶¶153-155), and organic polymers such as polyalkenes, polyacrylics, polyvinyls, polyimides, and polysilanes (¶¶158-159).

The use of these various substrates for alignment of liquid crystals was well established at the time of filing our patent application, widely known by those skilled in the art, and fully enabled by publications in the literature. For example, publications on the alignment of liquid crystals on inorganic glasses go back before 1990, see for example the publication:
SPUTTER-DEPOSITED SiO_x FILMS FOR LIQUID CRYSTAL ALIGNMENT
Author(s): MOTOHIRO T, TAGA Y
Source: THIN SOLID FILMS Volume: 185 Issue: 1 Pages: 137-144 Published: FEB 1990.

The use of metals for alignment of liquid crystals also has a long history, see for example, the publication from 1989 on the mechanisms of alignment of liquid crystals on metal surfaces, ROLE OF SURFACE BONDING ON LIQUID-CRYSTAL ALIGNMENT AT METAL

SURFACES
Author(s): SANDA PN, DOVE DB, ONG HL, et al.
Source: PHYSICAL REVIEW A Volume: 39 Issue: 5 Pages: 2653-2658 Published: MAR 1 1989.

Finally, the use of polymer films, such as polyimides, for alignment of liquid crystals at the time of filing of our invention was also well established and generally known by those skilled in the art, as evidenced by publications such as by the publication from 1987,
Title: ORIENTATION OF POLYMER CHAIN OF POLYIMIDE LB FILMS, AND ALIGNMENT OF LIQUID CRYSTALS ON THE LB FILMS
Author(s): NISHIKATA Y, MORIKAWA A, TAKIGUCHI Y, et al.
Source: NIPPON KAGAKU KAISHI Issue: 11 Pages: 2174-2179 Published: NOV 1987.

6. The application further describes that the surfaces of the substrates can be treated by mechanical or chemical techniques to cause anchoring of the mesogenic layers. ¶164. For example, the surface of the substrate can treated by rubbing, etching, stretching or oblique deposition or other similar techniques. ¶164. Thus, each of the substrates described above can be treated by multiple methods to provide surfaces that are suitable for use in liquid crystal biosensors. The application describes multiple substrates and surface treatments.

The use of rubbing as a surface treatment to align liquid crystals is well known by those skilled in the art. As an example, the examiner is referred to the paper published in 1991 entitled "HIGHLY ORIENTED THIN FILMS OF POLY(TETRAFLUOROETHYLENE) AS A SUBSTRATE FOR ORIENTED GROWTH OF MATERIALS" by WITTMANN JC, SMITH P, NATURE Volume: 352 Issue: 6334 Pages: 414-417 Published: AUG 1 1991.

As a second example of the well-known use of rubbing as a treatment to prepare alignment layers for liquid crystals, the examiner is directed to the publication from 1993 by LEE, E.S., DETAILED MORPHOLOGY OF RUBBED ALIGNMENT LAYERS AND SURFACE ANCHORING OF LIQUID CRYSTALS
JAPANESE JOURNAL OF APPLIED PHYSICS PART 2-LETTERS 32:L1822-L1825, 1993.

The use of oblique deposition of inorganic materials (such as SiO_x) to align liquid crystals is well known to those skilled in the art. As an example, the examiner is referred to the paper published in 1996,

"CONTROLLED TILTED HOMEOTROPIC ALIGNMENT OF LIQUID CRYSTALS FOR DISPLAY APPLICATIONS"
Author(s): VITHANA H, JOHNSON D, BOS P
Source: JAPANESE JOURNAL OF APPLIED PHYSICS PART 2-LETTERS Volume: 35 Issue: 3A Pages: L320-L323 Published: MAR 1 1996.

The examiner is also referred to the earlier paper, which established mechanisms of alignment of liquid crystals on obliquely deposited SiO_x,
Title: CURVATURE INDUCED QUASI-MELTING FROM ROUGH SURFACES IN NEMATIC LIQUID CRYSTALS
Author(s): BARBERO G, DURAND G
Source: JOURNAL DE PHYSIQUE II Volume: 1 Issue: 6 Pages: 651-658 Published: JUN 1991.

As yet another example that establishes the broad awareness of the use of oblique deposition of inorganic materials for alignment of liquid crystals in 1987, the examiner is referred to the publication
Title: ALIGNMENT OF CHIRAL SMECTIC-C LIQUID CRYSTALS BY OBLIQUE EVAPORATION METHOD
Author(s): UEMURA T, OHBA N, WAKITA N, et al.
Source: PROCEEDINGS OF THE SID Volume: 28 Issue: 2 Pages: 175-181 Published: 1987.

We also note that the use of silane chemistries to functionalize the surfaces of SiO_x surfaces for immobilization of biomolecules is well established and broadly known by those skilled in the art of surface modification. This is evidenced by publications from 1994, such as CYSTEINE-SPECIFIC SURFACE TETHERING OF GENETICALLY-ENGINEERED CYTOCHROMES FOR FABRICATION OF METALLOPROTEIN NANOSTRUCTURES
Author(s): HONG HG, JIANG M, SLIGAR SG, et al.
Source: LANGMUIR Volume: 10 Issue: 1 Pages: 153-158 Published: JAN 1994.

A second example of a publication describing the modification of the surfaces of silica with silane chemistry is published in 1993, namely, EFFECTS OF SURFACE HYDRATION ON THE DEPOSITION OF SILANE MONOLAYERS ON SILICA

Author(s): LE GRANGE JD, MARKHAM JL, KURKJIAN CR
Source: LANGMUIR Volume: 9 Issue: 7 Pages: 1749-1753 Published: JUL 1993.

Thus, as would be apparent to a reader of our patent application at the time of filing, the methods of surface treatment for alignment of liquid crystals described in our patent application are well understood and known to be useful for alignment of liquid crystals.

7. The application also provides specific examples of substrates and surface treatments. For example, glass or organic polymers substrates are prepared by rubbing. ¶165. Tissue paper, brushes, and rubbing paste treatments are used in the rubbing process. ¶165. As another example, metal layers are obliquely deposited on a substrate by evaporation. ¶165.

8. The description of multiple substrates and surface treatments in the application establishes that the invention is not limited to anisotropic gold surfaces.

9. The application further describes that in addition to anchoring of the mesogen layer by the substrate, anchoring can be provided by an organic layer attached to the substrate. ¶172. Multiple examples of suitable organic layers are described including biomolecules, organothiols, organosilanes, etc. ¶172. The application then describes different ways that the organic layer can be used to control anchoring. For example, organic molecules or polymers are coated onto a substrate such as silicon dioxide followed by a surface treatment such as rubbing. ¶177. As another example, the substrate is coated with a self assembled monolayer. Self assembled monolayers are described in detail at ¶¶187-252. The application specifically describes that the use of self assembled monolayers as the organic layer is exemplary and that the description generally applies to use of other organic layers:

> "[…] self-assembled monolayers are utilized as an exemplary organic layer. This use is not intended to be limiting. It will be understood that the various configurations of the self-assembled monolayers and their methods of synthesis, binding properties and other characteristics are equally applicable to each of the organic layers of use in the present invention." ¶185.

10. The application describes a number of different configurations of substrates and surface treatments useful for making liquid crystal biosensors. In the section of the Office Action entitled "The supporting disclosure," the Examiner has limited the analysis to paragraphs 145-146, 164 and examples 1-6. As described above, a number of other substrates and surface treatments are described in the application when it is examined. I have provided specific references to this description. The Examiner's conclusion that the description is limited to anisotropic gold hosting a self-assembled monolayer is incorrect and not supported by a detailed examination of the application.

Date: February 28, 2011 By: Nlabbott

Nicholas L. Abbott